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Research develops new outlets for honey

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SINCE 1948 a research program aimed at finding new and extended uses for honey has been carried out at the Eastern Utilization Research Branch* of the Agricultural Research Service, United States Department of Agriculture. To some extent this program continued research that had been under way in the Bureau of Agricultural and Industrial Chemistry in Washington, D. C., since 1929, but which was discontinued in 1943 when most of the Bureau's research was transferred from Washington, D. C., to the four Regional Research Laboratories.

In 1948, however, Mr. George P. Walton, who was in charge of the Bureau's honey research when it was discontinued in 1943, was transferred from the Production and Marketing Administration to the Bureau's Eastern Regional Research Laboratory, and honey research was again undertaken as a Research and Marketing Act project. Dr. J. W. White, Jr., was assigned to the project as Mr. Walton's assistant, and assumed charge of the work when Mr. Walton retired in 1949. At about this time Miss Jeanne Maher was added to the staff as Dr. White's assistant.

On resumption of honey research Mr. Walton continued certain phases of the work he had been conducting at the time the program was interrupted. One of these was research designed to develop a satisfactory honey-skim milk dry powder.

In addition, however, a broad program of utilization research was initiated at the time, with initial emphasis placed on better and more profitable utilization of the dark and strong-flavored types of honey that do not always find a ready market for direct table use. It was felt that treatment to modify the color and flavor might lead to better utilization of a considerable quantity of these dark and less readily marketed honeys, particularly in the baking industry.

Methods Developed

Two methods were developed. One based on treatment with a suspension of bentonite (a volcanic clay) gave a partially decolorized and deflavored product which still retained a good proportion of the original honey characteristics. A second method, based on more drastic treatment with decolorizing carbon and filter-aid, which was preceded by treatment with lime to neutralize part of the acidity, yielded a light-colored product with virtually none of the original honey flavor remaining. Both procedures require some dilution of the honey before treatment, followed by vacuum evaporation to original honey density.

Partially or wholly deflavored honey products are perfectly wholesome materials and, except for flavor and color, contain the original honey constituents in essentially the same proportions. The procedures for preparing these products are described in detail in a processed publication issued by the Laboratory (1).

* This is the new designation for what was formerly called the Eastern Regional Research Laboratory of the Bureau of Agricultural and Industrial Chemistry, United States Department of Agriculture.

Dehydrated Honey

IN COOPERATION with the Bureau of Dairy Industry, research on the preparation of a satisfactory honey-skim milk powder was continued. Concentrated milk and honey products of good storage stability were prepared, including honey-sweetened condensed milk, evaporated milk fortified with honey, and dried honey-skim milk with 40 per cent honey solids and 60 per cent skim milk solids.

Methods of manufacture and properties of the products are described in an article published in Food Technology (2). The preparation of dried honey-skim milk powder is covered by a public service patent (3). It is being evaluated for use as an ingredient in prepared baking mixes through a research contract with a commercial firm.

Since manufacture of prepared dry mixes for home and commercial baking is a very rapidly growing industry, successful inclusion of honey as dry honey-skim milk into one or more such prepared products would represent a very large potential outlet for honey. Its availability in this form would tend to overcome some of the more common objections to using honey in baking, i. e., its physical state (stickiness) and difficulty of handling in the bakery.

Honey-Fruit Spreads

In connection with studies on the utilization of dark, strong-flavored honeys, as described above, a bland, high-levulose syrup was prepared by decolorizing and deflavoring the less readily marketed honey types. It was felt that this syrup might be suitable for use in preparing products in which the flavor characteristics would be derived from sources other than the honey, such as a fruit juice or fruit puree.

Such products have been prepared as smooth spreads whose excellent texture is contributed by fine-grained crystallization of dextrose in the honey. Used in the same way as jams and preserves, they serve as delightful spreads for bread, toast, or crackers.

They are made by mixing fruit juice (or puree) and honey or honey syrup and finishing in vacuum to about 83 per cent solids. The mix is then subjected to controlled fine-grained crystallization to produce a smooth non-sticky consistency. Such crystallization is the basis for the natural honey product known as honey-spread, creamed honey, or Dyce-processed honey. The vacuum evaporation step may be avoided by using fruit juice concentrates. Various surplus fruits, purees, or byproduct juices may be converted into the crystallized spreads.

Fruit spreads have been prepared from honey and a wide variety of fruit materials. The spreads made from red raspberry, grape, loganberry, and orange are especially pleasing in flavor. At least two companies are producing and marketing honey-fruit spreads.

The Eastern Utilization Research Branch, Agricultural Research Service. U. S. Dept. of Agriculture. The main building contains more than 70 individual research laboratories besides the large pilot plant and special research rooms in the basement.

The preparation of these products is described in detail in articles appearing in Food Industries (4) and The American Bee Journal (5). It is covered by a public service patent (6).

Honey in Commercial Baking

ONE OF THE provisions of the Research and Marketing Act of 1946 is authority to contract research with organizations outside the Department. This has been a valuable means of conducting certain phases of our research, particularly when we do not have the special facilities needed to do a particular job. This provision also has enabled us to get more research done with the limited personnel assigned to the honey project.

Since we do not have facilities for conducting commercial baking tests at the Laboratory, research was carried out under contract with the Kansas Agricultural Experiment Station at Manhattan, Kansas, designed to determine the effects, if any, of the natural variability of honey in commercial baked goods.

Another object was to ascertain any advantages honey might offer over other saccharine products. This work was supported in part by funds from the American Beekeeping Federation.

Studies have included the use of honey in white and whole wheat bread and in various types of cakes and cookies. Extensive information on the use of honey in these products has been obtained that should be of considerable value in stimulating increased outlets in the baking industry.

The results show that by observing certain simple rules some of the difficulties encountered by bakers in using honey may be avoided. The results also indicate that acceptable types of honey improve the moisture retention and increase the shelf life of cakes. The properties of cookies, particularly the "chewy" types, are also enhanced by the use of honey. Findings as a result of this research appear in a number of publications (7, 8, 9, 10, 11).

Glass Color Standards for Extracted Honey

In cooperation with the Production and Marketing Administration of the Department (*), studies were conducted with a view to developing permanent glass color standards for extracted honey. While the Pfund Color Grader is satisfactory as a laboratory instrument, a simple and less expensive grading device was needed for official grading of honey.

Selection of suitable colored glasses to be used as standards was done by means of spectrophotometric measurements on filtered honeys, solutions of caramel in glycerin, and commercially available colored glasses. Commercial colored glasses were then found that duplicated closely both the visual colors and the spectral properties of typical honeys. The Department has arranged for the purchase of a large supply of the selected colored glasses so that an adequate supply for the estimated needs of the industry is assured.

The new color comparator (Fig. 1) containing the permanent glass color standards consists of two metal boxes having dimensions 8″ x 2″ and 3″ high, divided by thin partitions into five rectangular compartments, each of which has two windows approximately 1.2 inches square. The three lighter glass standards are mounted in one of the comparator boxes, and the three darker standards are mounted in a second comparator box. Provision is made to correct for turbidity of honey

(*) This work is now in the Agricultural Marketing Service of the Department.

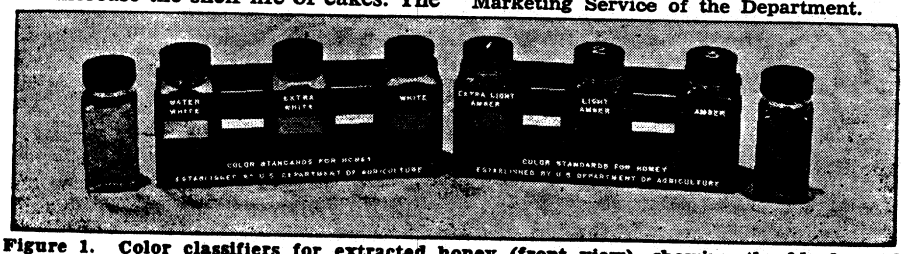
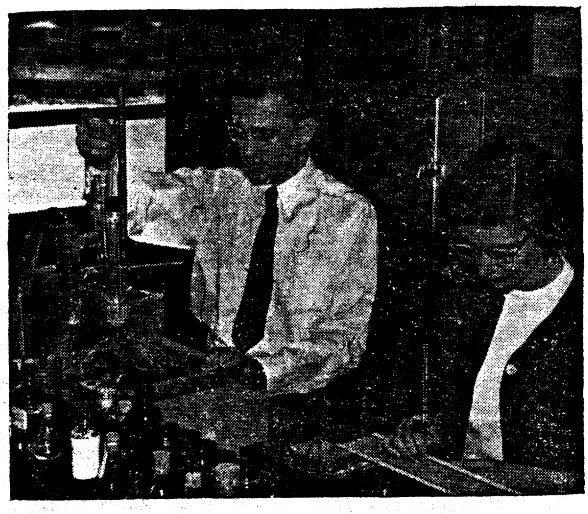


Figure 1. Color classifiers for extracted honey (front view), showing the blanks and cloudy suspensions in place behind the mounted color standards, and two samples of extracted honey to be classified.



Honey research staff at work in the laboratory. Left, Dr. J. W. White, chemist, in charge, and Miss Jean Maher, Chemist.

by use of diatomite suspension.

A complete description of the new color classifier for extracted honey is contained in a processed publication (12) issued by the Laboratory.

Composition Studies

WHILE CONSIDERABLE attention has been given to the analysis and composition of honey in the past (13, 14, 15), there is still much that is unknown regarding its composition, particularly with respect to the minor components. With the advance of analytical methods, particularly the development of new techniques such as chromatography, much of the older data on honey composition are in need of review.

A study of the action of honey invertase on sucrose was undertaken to learn more of the possible origin of some of the minor sugars of honey (16). The study suggests that these hitherto unreported sugars may be formed during the conversion of sucrose, which is present in the original nectar, into dextrose and levulose by the enzyme invertase, which presumably is furnished by the bee. While these sugars have not all been identified as yet, their presence would account for a part of the so-called unidentified fraction of honey.

One of the sugars formed by honey invertase from sucrose, for example, is a trisaccharide consisting of two molecules of glucose and one of levulose. Its technical name is alpha-maltosyl beta-D-fructofuranoside (17), and it has been isolated from a honey invertase digest of sucrose in a yield of 11 per cent of the original weight of sucrose.

Further studies along this line will undoubtedly lead to further elucidation of the composition of the so-called "undetermined" 6 per cent of honey. In fact, by using a new procedure based on use of an absorption column for separating the sugars into three classes, as much as 98 per cent of honey constituents are accounted for.

A comparison of the various methods for determining dextrose and levulose in honey has been made by Dr. White and Miss Maher. Their findings (18) indicate that certain of the methods in current use give higher precision for both dextrose and levulose than others that were investigated.

It might be pointed out that these various methods give much more concordant results when applied to mixtures of pure sugars made up to simulate honey than they do when applied to honey itself. This would indicate that certain constituents in the so-called "unidentified" components of honey interfere with the determination of dextrose and levulose.

As more information becomes available on the nature of the components of this unidentified fraction, the influence they exert on the procedures for determining the sugars can be

taken into account, with resulting improvement in the accuracy of analysis.

A new procedure for the determination of the sugars of honey was developed after the inadequacy of existing procedures was demonstrated. Employing carbon column adsorption as a pretreatment, the new method has reduced the "unknown" fraction of honey from about five to six per cent to less than two per cent (19, 20).

Granulation Studies

ONE OF THE troublesome problems in preparing liquid honey for retail trade is that of granulation.

Damage to honey frequently results from drastic heat treatment which is customarily used to lessen its tendency to granulate. Then again unless heat or other treatment is sufficient to thoroughly remove all crystals or crystal nuclei, granulation may take place on the store shelf, with resulting loss to the storekeeper. There is also a granulation problem in the packaging of chunk honey surrounded by liquid honey. While granulation of honey has not been extensively investigated here because of the press of work on other problems, it is one deserving of thorough study because of its importance to the industry. Investigations have been made, however, which have resulted in a simple procedure (21) by which the honey producer or packer can detect early granulation in his product so that appropriate treatment may be given.

The principle involved is to view a sample through polarized light when any small crystals of dextrose hydrate present appear as bright objects against a black background. This makes them more easily seen than when viewed with ordinary light. While the absence of visible crystals when honey is examined in this manner does not guarantee that it will not crystalize later, in general honey showing crystals under polarized light should be reprocessed to avoid early granulation.

It is hoped that this procedure may be helpful to the honey packer in determining the proper degree of processing so as to avoid excessive heating and at the same time prevent a condition that would lead to early granulation in the container.

Progress has also been made in controlling granulation of chunk honey packaged in a container surrounded by liquid honey. By coating the chunks with an edible pectinate before they are placed in the liquid honey, inoculation of the liquid honey by crystals of dextrose hydrate from the comb surface is prevented and crystallization thereby delayed. It has not been determined yet whether or not the process is a practically feasible one.

Sterilization of Honey

Another problem that has been investigated to some extent is that of sterilizing foulbrood-infected honey by heat or a combination of heat and bactericidal agents so as to permit feeding it to bees without danger of spreading the disease. This work was carried out in close cooperation with the Bee Culture Laboratory of the Department.

Thermal death time studies on the spores of **Bacillus larvae** were carried out in order to provide a basis for a method for sterilizing honey (22). At an acidity of pH 3.0, the following heating conditions were required to reduce viable spore populations to less than 1 in 10 milliliters: 160 minutes at 212° F., 41 minutes at 230° F., 8.6 minutes at 250° F., 1.9 minutes at 269° F. and 0.64 minute at 284° F. Various sporicidal agents were also tested, but it was found that the only effective ones were too toxic to bees.

A process has been developed for treatment of honey so that it may be used for bee feeding without danger of spreading American foulbrood. It will be described in a forthcoming publication.

Present Program

ALTHOUGH the broad objective of our utilization investigations on honey remains the same, i.e., to develop new and expanded uses through chemical, physical and biological research, the specific problems being studied do undergo change more or less constantly. In general, about two years is allowed to complete a specific phase of work.

Since the technical staff conducting research on honey at present is small, only a limited number of problems can be studied at one time. At present

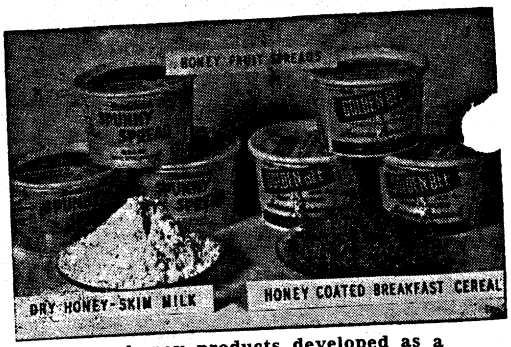
the principal fields of work being given attention are: increased utilization of honey in commercial cake baking; evaluation of dry honey-milk as an ingredient of prepared baking mixes; and improvement in methods of analysis of honey, which will lead to a better understanding of its composition and behavior.

Two of these problems, honey in commercial cake baking and evaluation of honey-milk powder, are being studied primarily through research contracts. There are, of course, other problems on honey that are in need of investigation, and these will be dealt with as rapidly as progress on the present program permits undertaking additional work.

Some additional problems on which research would appear to be profitable are: studies to develop increased uses of honey in the confectionery industry, use of honey as a humectant for cigarette tobacco, increased use of honey in pharmaceutical preparations, and studies on the granulation of honey.

There would certainly appear to be room for increased use of honey in candy manufacture, where comparatively little is used at present. Developing information about the types of honey best suited for candy making and overcoming some of the technical difficulties in using honey for this purpose should be helpful in stimulating this outlet. (Ed. note: See February through May Gleanings for a detailed report on Honey Candy.)

Basic investigations on the composition and behavior of honey are needed to develop information that can be used to improve our processing methods and to overcome technical problems in using honey for baking, candy making, and other industries.



Some new honey products developed as a result of research conducted at the Eastern Utilization Research Branch.

Honey Research Should Benefit Agriculture as a Whole

As most everyone connected with apiculture knows, the value of bees as pollinating agents for crops is several-fold that of honey and beeswax produced. Yet in spite of this large value to agriculture, virtually the only monetary incentive the beekeeper has for keeping bees is the financial return from the sale of his honey and beeswax.

This is all the more reason for intensifying our efforts to develop profitable outlets for every pound of the honey that is produced. In this way beekeeping will be kept in a healthy condition, which in turn will preserve the value of our bees to agriculture through pollination of crops.

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